Water Demand Forecasting

SAD Water Supply Conference
Wilmington, NC

David Luckie (CESAM-PD)
251-690-2608

US Army Corps of Engineers
MOBILE DISTRICT

Completed & Ongoing Studies

- Post Authorization Change Notification Report, Lake Lanier 1989
- Carters and Allatoona Reallocations, 1991
- ACT & ACF Comprehensive Studies, 1994-1996
- Black Warrior Headwaters Basin Section 22, Birmingham, AL, 1995-1996
- ACT & ACF Programmatic EIS' 1998
- Choctawhatchee Pea & Yellow Rivers Basin Section 22, Southeastern Alabama, 2001
- Jackson County, MS Water Supply Project, 2002
- Okaloosa County, FL Section 22

US Army Corps of Engineers
MOBILE DISTRICT

Why do we care?

- Project design issues
- Contractual issues
- Environmental impacts
- Economics (NED & RED)
- Financial impacts
- Public Confidence

US Army Corps of Engineers
MOBILE DISTRICT

What is “Demand?”

- Demand: The amount of water desired by an aggregate consumer base, given:
  - Price
  - Weather
  - Season
  - Time
  - Economic setting

US Army Corps of Engineers
MOBILE DISTRICT

The Gadget Box

- IWR-MAIN - The Corps Standard
- CorpsWater - Spreadsheet Model from Mobile
- Your own models
- The Rule of Thumb

US Army Corps of Engineers
MOBILE DISTRICT

IWR-MAIN

- Experience
- High degree of accuracy
- Hungry!
- Some knowledge of factors influencing water demand

US Army Corps of Engineers
MOBILE DISTRICT

CorpsWater

- More uncertainty
- Less flexibility
- Easy to use
- Relatively cheap
- Not as data hungry

US Army Corps of Engineers
MOBILE DISTRICT

The Rule of Thumb

- 150 gallons per person per day
- 100 gallons per employee per week
- Obviously cheap
- Obvious issues on uncertainty

US Army Corps of Engineers
MOBILE DISTRICT

Which Tool?

- Let Size and Complexity Decide
- IWR-MAIN:
  - Watershed level studies
  - Cross state boundaries
- CorpsWater/Spreadsheet Models:
  - Single utility
  - Small geographic area

US Army Corps of Engineers
MOBILE DISTRICT

IWR-MAIN Features

- Disaggregation
- Seasonal models
- Indoor/Outdoor fractions
- Sensitivity
- Price Elasticity
- Driven by housing stock & employment
- Conservation Manager
- Benefit/Cost Analysis
- Actively developed & updated

US Army Corps of Engineers
MOBILE DISTRICT

Mobile District's CorpsWater

- Spreadsheet Model--Small, Easy, Quick
- Seasonal Models
- No Price Elasticity
- No Indoor/Outdoor fractions
- Not as sensitive
- No Conservation Analysis
- No Black Boxes!
- Developed & updated as project funds permit

US Army Corps of Engineers
MOBILE DISTRICT

What We’re Good At

- Residential Water Demand
- Non-Residential Water Demand
- Public-use Water Demand
- Estimating Shortage Risk using other tools

US Army Corps of Engineers
MOBILE DISTRICT

What We’re NOT Good At

- Thermal Power Generation
- Agricultural Water Demand
- Mining

US Army Corps of Engineers
MOBILE DISTRICT

You Need Data

- Many variables affect water demand:
  - Population, housing, employment, income, weather, household size, water price, culture, lot size, growing season…
- The key variables:
  - Housing units, employment, weather

Potential Data Sources

- Census Bureau
- Water Utilities
- National Weather Service
- US Geological Survey
- State, Regional, Local Planning Agency
- County Extension Agent

US Army Corps of Engineers
MOBILE DISTRICT

Seasonal Use Patterns

- Summer Use vs. Winter Use
- Less variability in non-residential sectors
- Seasonal and Peak Use drive system design
- Drought contingency
- Conservation plans

US Army Corps of Engineers
MOBILE DISTRICT

Sectoral Use Patterns

- Residential
  - Single family
  - Multifamily
  - Mobile Home
- Non-Residential
  - Two Digit SIC (basic)
  - Custom Model

US Army Corps of Engineers
MOBILE DISTRICT

Unaccounted for Water Use

- Water lost to theft, leakage, flushing and accidents
- Firefighting
- Un-metered public use
- American Water Works Association target set to 10% of metered use

US Army Corps of Engineers
MOBILE DISTRICT

Basic Demand Forecasting

- Collect & analyze historical use data
- Prepare water demand model(s)
- “Back-cast” history
- Calibrate by altering intercept
- Forecast future demand
- Interpret and analyze results

US Army Corps of Engineers
MOBILE DISTRICT

Basic Demand Forecasting

- Tips:
  - Use more than one growth scenario
  - Use AWWA Target of 10% Unaccounted
  - Forecast demand assuming it will be supplied

US Army Corps of Engineers
MOBILE DISTRICT

Advanced Demand Forecasting

- Use IWR-MAIN
- Survey users
- End use coefficients
- Indoor/Outdoor fractions
- Seasonal use models
- Calibrate by altering model coefficients

US Army Corps of Engineers
MOBILE DISTRICT

Conservation

- Passive - Relatively cheap, voluntary measures to reduce consumption
- Active - Expensive, coercive measures to reduce consumption

US Army Corps of Engineers
MOBILE DISTRICT

Conservation

- Passive vs. Active Conservation:
  - Passive:
    - Education
    - Voluntary retrofit
    - System loss reduction
  - Active:
    - Price changes
    - Utility sponsored retrofit
    - Code changes

US Army Corps of Engineers
MOBILE DISTRICT

Conservation

- Passive conservation measures rarely reduce aggregate demand
- Active conservation measures often reduce aggregate demand, but not always

US Army Corps of Engineers
MOBILE DISTRICT

Pitfalls

- Crude non-residential modeling
- Schools, hospitals, prisons, golf courses
- Vacation homes

US Army Corps of Engineers
MOBILE DISTRICT

Gee Whiz!

- Tampa Florida has residential water use of about 63 gallons per customer day
- Birmingham, AL: 251 gals/day
- Dothan, AL: 289 gals/day
- High Density multifamily housing will usually have the highest residential use rate. Why?
- What device or appliance in the home uses the most water?
- What nonresidential sector uses the most water per employee?

US Army Corps of Engineers
MOBILE DISTRICT